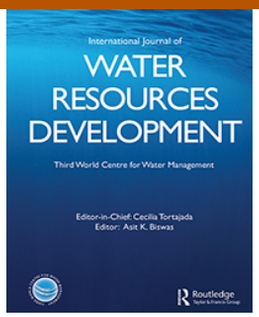

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Evaluating media framing and public reactions in the context of a water reuse proposal

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ABSTRACT

The public is increasingly engaging with information about water reuse proposals through the Internet. Though there are benefits to engaging the public online, there may also be challenges associated with media bias or online advocacy. This study qualitatively examines the public response (online comments, n = 1323) to online news reporting an indirect potable reuse proposal for London. The study found no evidence of the media's framing of the event strongly shaping the unsolicited online public reactions. Findings suggest that though communications may struggle to counter longer-term news agendas, there may be benefits to experimenting with framing water safety measures and shorter-term gains.

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Media framing; online communication; public engagement; social media; water reuse

Introduction

Globally, as climate change and population expansion challenge existing water supply regimes, the number of water reuse schemes and proposals is growing. Public support is crucial for new schemes, and water resource planners and managers are conscious of potential opposition (Hurlimann & Dolnicar, 2010). Thus, there is an ongoing challenge for water service providers to constructively engage with diverse societal concerns and to build support for both the principle of water reuse and individual projects. The news media can play an important role in conveying information (Hurlimann & Dolnicar, 2012; Lee & Tan, 2016) and shaping perceptions of water management issues (Mistry & Driedger, 2012). In the context of water reuse, there are particular interests in understanding the potential challenges arising from negative media campaigns (Hurlimann & Dolnicar, 2010) such as 'toilet to tap' framings (Rozin, Haddad, Nemeroff, & Slovic, 2015) or antagonistic media relations (Hartley, 2006). However, there are also many potential benefits of proactively engaging with the media (Harris-Lovett, Binz, Sedlak, Kiparsky, & Truffer, 2015) and building positive relationships (Simpson & Stratton, 2011).

Public acceptance of water reuse schemes, particularly those designed to supplement drinking water supplies, is shaped by specific contextual factors. Examples include public perceptions of economic bias in San Diego's unsuccessful water reuse scheme proposal during

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the 1990s (Hartley, 2006) and, in the case of Toowoomba in Australia, concerns about the town's image and health risks (Hurlimann & Dolnicar, 2010). Despite a body of international research spanning back to the 1970s (e.g. Bruvold, 1972), there remain limitations to current understanding of how specific communities might respond to particular water reuse proposals (Hurlimann & Dolnicar, 2016; Ross, Fielding, & Louis, 2014). This may be due to the breadth of public responses which can be influenced by consumers' expectations (Marks & Zadoroznyj, 2005), worldviews (Price, Fielding, & Leviston, 2012) or personal experiences (Leong, 2016).

Public attitudes and behaviours are known to be influenced by the media, which can alter public perceptions of risk (Kasperson et al., 1988) and trust in different sources of information (Mase, Cho, & Prokopy, 2015). Social norms, pre-existing attitudes (Pan & Kosicki, 1993) and other social conditions can also contribute to shaping public reactions to media and risk events (Kasperson et al., 1988; Leiserowitz, Maibach, Roser-Renouf, Smith, & Dawson, 2013). The media's interaction with the public is also dynamic, and though news outlets can be responsive to changing public opinions, they can also selectively provide information to set agendas and help shape public opinion (Carvalho & Burgess, 2005). Thus, media outlets can employ 'frames' in their reporting practices, which are used to promote a particular problem definition (Entman, 1993). A 'framing effect' occurs if the characteristics of media coverage affect the public's interpretations (Scheufele, 1999).

Media framing may contribute to polarizing community attitudes towards water management (Wei, Wei, Western, Skinner, & Lyle, 2015). Research has focused on content analysis of media reporting of water management (Hurlimann & Dolnicar, 2012; Xiong, Wei, Zhang, & Wei, 2016), and specifically water reuse (Leong, 2010; van Vuuren, 2009), to identify framing perspectives. Though past research has revealed bias and framing in media reporting around water reuse – including an emphasis on uncertainty (Hurlimann & Dolnicar, 2012) and 'toilet to tap' framings (Marks, 2006) – less is known about how the public might respond to such framing practices. This is relevant to water reuse, as it has been suggested that media framing (including speculation over health risks) has reduced public confidence in specific scheme proposals (e.g. the Western Corridor, Australia – Ross et al., 2014). Conversely, ongoing public engagement and proactive media outreach may also increase public support, as is suggested for schemes in Orange County (Harris-Lovett et al., 2015) and Singapore (Leong, 2010; Mainali et al., 2011).

Both the news media and the public are increasingly turning to the Internet to disseminate information, and debate the pros and cons of different issues (Westerman, Spence, & Van Der Heide, 2014). For example, Regan et al. (2014) thematically explored dietary heath risk perceptions through online comments on two online media articles. Correspondingly, there is increased interest in studying online interactions across a range of water resource management domains, including through online participation tools (Bojovic, Bonzanigo, Giupponi, & Maziotis, 2015; White, Kingston, & Barker, 2010), social media (Tang, Zhang, & Xu, 2015) and online comments (Russell-Verma, Smith, & Jeffrey, 2015). A recent exploration of online comments on an aquifer recharge proposal (river water) in Finland concluded that debate on the subject was prone to polarization and lacked attention to benefits and risks (Lyytimaki & Assmuth, 2014). Unsolicited online commentary therefore presents an opportunity for insight into public responses to real-world reuse scenarios. Though public responses to individual fictional news articles have been studied (Kemp, Randle, Hurlimann & Dolnicar, 2012), the influence of actual media reporting on public responses to a real water reuse proposal has not yet been examined.

This study responds to calls for more in-depth considerations of the influence of media reporting on public responses to water reuse (Leong, 2010; Lyytimaki & Assmuth, 2014) and the potential benefits of media monitoring for developing responses to public concerns or to negative reporting (Hurlimann & Dolnicar, 2012). This research examines a recent proposal to implement indirect potable reuse (IPR) in London (UK) and uses this context to explore how the news media reported on the proposed scheme, as well as public reactions to those reports captured through unsolicited online commentary. The principal questions that this contribution seeks to address are: (1) How did different news organizations in the UK frame the proposed reuse scheme in online articles? (2) how did the public respond to the articles, and how did those responses articulate perceived justifications for the scheme (e.g., water shortages) and perceived impacts of the scheme (e.g. risks, benefits)? And (3) to what extent did a framing effect occur (i.e., did the media's framing of the scheme seemingly influence the public's online responses)? The following sections present the context for the IPR scheme in London, outline the methods and present the results. The discussion then considers the implications of the research findings, particularly in light of current understandings around the use of: (1) online commentary as a mechanism to gauge public reactions and (2) proactive media outreach to engage the public on water reuse scheme proposals.

IPR for London

A projected water supply deficit was highlighted in Thames Water's (2014) most recent Water Resource Management Plan for London. This deficit is expected to be driven by a combination of climate change impacts, reductions in the licensed abstraction volumes, and population growth (Huskova, Matrosov, Harou, Kasprzyk, & Lambert, 2016). To help address it, the water company has proposed a number of water supply augmentation options, one being an IPR scheme. The IPR option includes advanced treatment of wastewater from a sewage treatment works that is then returned to a river upstream of an abstraction point of a drinking water treatment plant. The suggested reuse option is for a 150 ML per day scheme, programmed for 2027, which will follow a substantial demand management programme and smaller groundwater and water transfer schemes (Thames Water, 2015). The IPR option contrasts with existing instances of unplanned (or de facto) IPR, in which, due to historical developments along waterways, some sewage treatment works already discharge into rivers upstream of abstraction points. Treated wastewater is known to contribute to base flow in the River Thames (and its tributaries), and this proportion can be significant in dry weather conditions (Crook, Mosher, & Casteline, 2005). This is relevant to an IPR proposal as there is already a level of public awareness and acceptance of this state of affairs (Hills et al., 2009).

Previous public perception research has indicated the public is receptive to an IPR scheme proposal for London, with 60% of respondents indicating that they were supportive (Aitken, Bell, Hills, & Rees, 2014). However, the same study also identified that public support may be contingent on trust in the authorities that manage planned reuse and that this trust may be influenced by evaluations of other aspects of water supply and management (such as water leakage and cost). Moreover, in contrast with other international cities, past media coverage of water management issues in London has been shown to be critical of the privatized nature of the water industry (Bell, 2009). It is also worth noting that Thames Water's announcement of its IPR proposal, and its subsequent coverage in the news media, occurred following a series of notable meteorological events. In the spring of 2012, after two successive

dry winters, Thames Water (along with other water companies) implemented water use restrictions in anticipation of severe drought over the summer (Thames Water, 2013). This was followed, in the summer of 2012, by a period of record rainfall and flooding in the south of England (Met Office, 2016), which caused many to question water companies' motivations in retaining water use restrictions (Russell-Verma et al., 2015). With respect to this study, such antecedent events may have had an influence on public expectations and discussions of water use and supply in London.

Methods

Data collection and selection

News articles and associated online comments were collected using online search engines, social media searches and Factiva (an online, subscription-based, news and information management resource), combining the following search terms with Boolean expressions: *London, drinking, wastewater, sewage, recycling* and *water reuse*. The search was purposive and focused on identifying Internet sources with news and comments relating to a statement released by Thames Water in May 2013 describing their IPR water resource option. Searches returned 35 websites that included 21 individual news articles and 1708 online comments. The complete data-set collected is summarized in the Appendix, Table A1. Comments included those posted on news media websites and those on social media (e.g. Facebook). They ranged in length from one word to some longer pieces of over 500 words but were typically one or two sentences. Many of the articles reported on or reproduced news content that originated in six articles from six prominent UK media organizations. Thus, the articles, secondary sources and comments were organized into cases corresponding to these original six articles. In addition, there were some other UK and other international news sites that did not relate to these six articles.

The six media organizations that produced the central articles were prominent in the sense that they included the BBC (public service broadcaster) – the most used online news source in the UK (Newman, Fletcher, Levy, & Nielsen, 2016) – and 5 of the 10 most widely read online daily newspapers, both in Greater London and nationally (National Readership Survey, 2016). The UK has a diverse news market, with some notable differences between major news outlets in terms of their content and editorial stances. On this basis, the six articles were purposively selected as they represented the breadth of the UK broadsheet and tabloid news with London representation (Table 1).

Other articles and their associated comments were excluded from the analysis (Appendix, Table A1). Some of the excluded articles were produced by regional UK news sites with limited reach and readership. Two of the excluded articles were produced by news outlets based in India and received no comments. The secondary articles that reported on the six principal articles were also excluded (see Suran, Holton, & Coleman, 2014, for similar exclusion criteria). These consisted of UK and international websites mainly containing environmentally focused news and discussion forums. These articles were excluded as they either reproduced the content of the six principal articles or were located on specialist websites with specific agendas and limited reach (some had no comments).

There are notable differences between the readerships of different news sites based on their demographic profiles, political orientations and their perceptions of certain socially

Table 1. A summary of the news articles and comments selected for analysis.

Case	Description of news source*	National readership rank†	Article references and date published	Title of article	Online sources for article and comments	Online comments	Social media posts	Total	Total coded	% coded
BBC	National public broadcaster, no print version, politically neutral	**	BBC, 10 May 2013	London 'could drink treatedsewage' - Thames Water	BBC website and Facebook pages, Reddit, Twitter	0	105	105	39	37%
Daily Mail	Tabloid, popularist, politically right-wing, conservative	1	McDermott, 10 May 2013	Would you drink sewage? What millions will be asked as suppliers desperately try to beat water shortages	Daily Mail website and Facebook page, Twitter	685	128	813	254	31%
Evening Standard	Regional (London) free paper, politically centre-right, conservative	8	Cecil, 9 May 2013	Drinking treated sewage could be the answer to the capital's water shortage, says Thames Water	Evening Standard website, Twitter	28	32	60	39	65%
Express	Tabloid, popularist, politically right-wing conservative, Eurosceptic	10	La Borde, 10 May 2013	So, would you like to drink recycled sewage? - Weird – News	Express website and Facebook page	9	42	51	34	67%
Guardian	Broadsheet, politically centre-left, liberal, social-democrat	6	Saner, 10 May 2013	Poll: are you happy to drink recycled sewage water?	Guardian website, Twitter	98	66	164	82	50%
Telegraph	Broadsheet, politically centre-right, conservative	4	Dixon, 9 May 2013	Householders asked if they would drink treated sewage water	Telegraph website, Twitter	107	23	130	89	68%
					Total	927	386	1,323	537	41%

*See Anderson, Allan, Petersen, & Wilkinson, (2005); Boykoff (2008); Carvalho and Burgess (2005).; **The BBC is the most read online source (Newman et al., 2016) but is not ranked with the news brands.

†Total online and print for combined daily and weekend editions in 2015 (National Readership Survey, 2016).

charged issues, such as immigration (Duffy & Rowden, 2005). On this basis, it was concluded that the online comments responding to these six UK news articles could represent a diversity of opinions with knowledge of London's water resource management context. Comments were included in the analysis where they directly responded to one of the six articles. Comments were excluded if they did not respond directly to one of the six articles, or there was insufficient text to enable the semantic meaning to be labelled and categorized. Though it was not possible to determine the geographic location of many commenters, it was clear that many had experiences of London. Moreover, overall, the responses to the six selected articles demonstrated knowledge of the water resource management context of London and south-east England, existing water supply arrangements as well more exogenous social and political factors. The data selected for analysis originated from 13 different online sources (including news websites and social media sites) and encompassed the six articles and 1323 comments.

Analytical approach

The six cases were used to organize and analyze the data using a framework-based approach (Ritchie & Lewis, 2003).This study used an inductive, data-driven thematic analysis and followed methods outlined by Braun and Clarke (2006). Coding was used to sort the news article content and comment data into categories, and tables were then used to organize the data by themes and cases. Comments were not coded if they clearly did not reflect on the London (or south-east England) water resource context. Coding was also halted for a particular set of comments if it was judged that saturation had been reached – i.e., no new concepts were emerging from reviewing successive data. This occurred in the comments responding to the *Daily Mail* article (C2.S8.A2).[1] In this instance, the relatively large volume of comments (685) contained much repetition. Therefore, though *Daily Mail* comments dominated the sample, they did not dominate the analysis. Coding was undertaken using QSR International's NVivo software (versions 10 and 11), and Microsoft Excel 2010 was used to organize themes into tables for comparison.

Coding was largely semantic, but due to the abbreviated nature of some comment data, some interpretation of latent meaning is acknowledged. A codebook was used to define codes and outline assumptions or interpretations made when coding. Data were coded that described perceptions of: (1) the water resource context for London; (2) the causes of the water supply deficit; (3) potential consequences of the scheme (e.g. risks or benefits); and (4) scheme barriers and preferences for management initiatives. The data were also categorized based on the sentiment expressed towards the proposal, using labels for neutral, positive, negative, or mixed sentiment (Feinberg et al., 2015). The unit of analysis for coding related to a text segment that conveyed a single idea and therefore could be the entire comment or a single word (Braun & Clarke, 2006; Ledford & Anderson, 2013; Price et al., 2012; Russell-Verma et al., 2015; Suran et al., 2014). For example, some of the coded text for 'yuck as a perceived scheme barrier' consisted of few words, such as 'Eww!' (C1.S5). On the other hand, many single ideas were conveyed using more descriptive text. NVivo ('query' and 'explore') and Excel functions were used to aid the interrogation of the data and codes – this included quantification of the number of sources and text segments coded for each of the cases.

Themes were developed and refined by first sorting the codes then through iteration with the aid of thematic network maps to understand how themes related to each other. A random sample of 10% of the comment data was double-coded by a second researcher, and the level of inter-coder agreement was high (>95%). The percentage agreement of above 80% indicated that the coding was reliable (Hurlimann & Dolnicar, 2012), and though there are limitations to this method, it is appropriate for qualitative analysis (Campbell, Quincy, Osserman, & Pedersen, 2013; Carey, Morgan, & Oxtoby, 1996).

The analysis of the news articles themselves also drew on media framing analysis concepts (Pan & Kosicki, 1993; Scheufele, 1999). The analysis, therefore, sought to identify the salient themes of the articles and whether certain problem definitions were being promoted. Media framing concepts helped focus the analysis on identifying features of the articles for both their structure, such as the arrangement of words or phrases, and their functional elements, such as images, terminology, language and tone (Entman, Matthes, & Pellicano, 2009). The analysis also considered the use of frame typologies describing generic or issue-specific themes (Entman et al., 2009) along with losses, e.g. costs, or gains, e.g. benefits (Holton, Lee, & Coleman, 2014). However, it was not within the scope of this study to evaluate the nature of external factors that may have influenced the selection of media frames. The articles were published over a short period of time (9–10 May 2013) and thus the analysis was concerned with framing around a single issue or event, rather than longer-term agenda setting.

To explore the potential influence of the article frames on the responses (i.e. the online comments), again, framing analysis concepts were employed using the definition that 'a framing effect occurs when audiences pay substantial attention to news messages' (Scheufele & Tewksbury, 2007). This stage of analysis sought to qualitatively examine whether there was evidence that the media frames, considered as an independent variable, could be said to resonate with popular knowledge (Escobar & Demeritt, 2014) and, more specifically, to influence the responses (Scheufele, 1999). Drawing on pattern-matching techniques (Yin, 2012), the proposition was that a framing effect would be indicated if similar patterns of themes and relative strength of sentiment (as coded) were observed between the articles and comments, across the cases. This was achieved by comparing the salient article framing characteristics with the audience's interpretations of the information presented, as reflected in the comments. Though this was qualitatively determined, quantitative outputs (e.g. proportion of comments per theme) were also reviewed to aid the interpretation. Given the wide range of compounding factors shaping the online comments, the findings from this analysis are indicative (rather than conclusive), but can nonetheless offer insight into the potential relationship between media framing and public responses.

This study was subject to review and approval by the university's research ethics committee, and it followed associated advice for conducting online research. Guided by this advice and previous related studies (Regan et al., 2014), paraphrased quotes were used where possible to reduce the traceability of individual comments through online searches and to keep quotations anonymous.

Limitations

There are recognized shortcomings to using online comments as data, including inability to gauge the representativeness of a given sample (due to lack of information about commenters), the exclusion of individuals without Internet access, and a prevalence of inaccurate

information in comments (Anstead & Loughlin, 2015; Jaspal, Nerlich, & Koteyko, 2012). Therefore, it is widely acknowledged that people commenting online are not wholly representative of the views of the broader population (Regan et al., 2014). Moreover, a number of studies show that people commenting online are likely to voice strong opinions or exaggerate, and their comments are more likely to be negative or disagree with the subject matter (Beninger et al., 2014; Regan et al., 2014). Therefore, online comments are more likely to represent the extremes of public opinion rather than the average. However, though online comments cannot be interpreted as generalizable (Regan et al., 2014) and there are other limitations, these online spaces do give individuals the opportunity to engage in extended conversations and present unsolicited reactions to both the articles and other commenters (Suran et al., 2014). The views offered therefore accurately reflect how *some* people react to issues presented in the news media and can provide insight into opinions that are not affected by researcher bias in survey questions (Regan et al., 2014; Russell, Lux, & Hampton, 2008).

Results

The findings reported below help address the principal research questions. The following sub-sections outline: (1) the identified characteristics of how the media framed the water reuse proposal; (2) the characteristics of public responses identified in the online comments; and (3) an interpretation of article framing effects.

Media framing of the news event

All of the articles alluded to a sense of disgust, using 'toilet to tap' as a dominant frame and particularly through introducing some version of the somewhat misleading concept of 'drinking sewage' in the headlines. Regarding the use of imagery, with the exception of the *Express* (who used an image of a urinal) the articles used fairly generic and neutral water-related pictures, such as taps with flowing water. The *Evening Standard* and *Daily Mail* articles differed in their choices and included pictures of water treatment works. In terms of sources of information, all of the articles referred to the Thames Water spokesperson as their main source. Only two articles directly quoted other sources. The *Guardian* provided the perspective of a microbiologist, and the BBC provided three quotes from the public in the article (all negative towards the proposal). The *Evening Standard* made reference to members of Parliament who 'are encouraging local people to respond' (C3.S11.A4) (Cecil, 2013) and to Southern Water (a water company that covers areas to the south of London and is also considering similar proposals). No other organizations were mentioned in any of the articles.

There was evidence of the selective presentation of information being used as a framing technique in the articles. For instance, only one article (*Evening Standard*) indicated the inclusion of additional water treatment technology to ensure safety: 'It involves putting treated effluent from a sewage works through a further process which allows the effluent to be returned to a river at a higher than usual quality' (C3.S11.A4) (Cecil, 2013). Another example of the selective presentation of information was found in the *Guardian* article, which was the only one to introduce possible beneficial impacts, or gains, from the scheme. These environmental benefits of more flow in the river were also weighed against potential environmental impacts (river pollution, including higher levels of pharmaceuticals) and the

potential for trade-offs between water treatment costs and risk management. Three articles (*Express*, *Evening Standard* and *Daily Mail*) mentioned that the water would be treated to drinking water standards, for which the *Daily Mail* provided additional detail on the drinking water treatment processes (including the removal of pesticides and organic compounds and disinfection). The importance of public perception was put forward in three of the articles, with the *Guardian* focusing on its relevance to the proposed IPR scheme for London, while the *Evening Standard* and the *Telegraph* highlighted public opposition to other unsuccessful international schemes. All six articles highlighted that *de facto* water reuse already occurs in London, and how predicted population growth could exacerbate possible water shortages.

With the exception of the BBC, the articles: (1) mentioned that IPR was being considered as one of a number of options; (2) gave a brief definition of IPR; and (3) discussed variations of the popular perception that the existing water supply has passed through 'seven sets of kidneys' before it reaches taps in London. Thus, in terms of framing out certain information, it was notable that the BBC was the only case not to introduce these three aforementioned matters in either the article or associated sources (i.e., Facebook-page introductions to the story). Also of note was the comparative brevity of the BBC article (the shortest article, with 267 words), particularly given that it is the most used online news source in the UK. Other noted exclusions included the *Guardian* as the only article not to mention reuse being practised internationally. Thus, the presence or absence of certain information provided evidence of framing. It was not within the scope of this study, however, to evaluate the reasoning behind these choices, except to note that different editorial and journalistic preferences (along with time pressures, for example) and antecedent events are likely to have played a part.

The *Guardian* article introduced the potential uncertainty of health risks ('the pharmaceuticals in sewage are quite resistant to breaking down') and environmental impacts ('If there is no further treatment of the sewage before they inject it into the rivers, that could have implications for things that live in the river'), along with the possible costs associated with managing these risks ('It's a problem that can be solved by throwing money at it.'), adding that 'the water is going to be from sewage effluent and that's more of an unknown' (C5.S18.A8) (Saner, 2013). These extracts were collectively classified during the analysis as potentially being used to introduce uncertainty and doubts to readers regarding the potential impacts of the water reuse scheme proposal (hedging). In contrast, themes relating to water safety management (e.g., the existence of a research programme, the capabilities of water treatment technology and the presence of drinking water standards) and to the nature of the water cycle were categorized as being presented with more certainty and optimism (and reassurance) towards the prospects of the proposal.

The analysis identified the use of both generic and issue-specific themes in the media frames. The more generic theme of water shortages being caused by population growth was identified across all of the articles. In all instances, this theme was used in defining the problem and a potential for loss, for example: 'could lead to usage bans and eventually see some homes without enough water' (C6.S28.A16) (Dixon, 2013). In some cases this theme encompassed descriptions of more sensational consequences, for example, 'drastic measures will be needed' (C5.S18.A8) (Saner, 2013). Some articles also emphasized specific elements of the proposed scheme design, thus encouraging the reader to consider the possibility of problems. For example, two articles (*Express* and *Telegraph*) emphasized that the recycled

water from the proposed scheme would be returned closer to drinking water treatment works than instances of *de facto* reuse:

> Waste water … is currently treated and returned to the environment *miles* from treatment works which process drinking water. But the new process being investigated would mean toilet water which has been treated will be *put straight back in* a river upstream of a water treatment plant. (C4.S16.A6 – emphasis added) (La Borde, 2013)

Overall, the BBC (albeit briefly), *Daily Mail* and *Evening Standard* were identified as more balanced in terms of the use of positive and negative sentiments towards the proposal (e.g., through tone, emphasis and selection of information). On the other hand, the *Telegraph*, *Express* and *Guardian* were evaluated as somewhat more negatively biased in their overall sentiment towards the proposed reuse scheme. Despite these observations, however, it is worth noting that much of the articles' representations of the scheme was also categorized as having a neutral sentiment.

Public responses

Five thematic categories emerged from the qualitative analysis of the online comments describing characteristics of the public's response to the proposed IPR scheme. These were (1) perceptions of water quality and risks, (2) trust in organizations to manage water resources, (3) perceptions of underlying problems and their root causes (e.g., population growth as a root cause for impending water shortages), (4) environmental conservation values, and (5) perceptions and knowledge of the climate and the water cycle. Together, these characteristics appear to shape commenters' reactions towards the proposed reuse scheme and their broader preferences for supply-side or demand-side solutions.

Perceptions of water quality and risks identified in the comment data were associated with both health-related matters and also other water quality characteristics such as taste or hardness. This theme was evident across all of the cases and generally referred to perceived negative impacts, or losses, associated with the proposed reuse scheme. Health risk perceptions were expressed relating to a range of contaminants, including pathogens and pharmaceuticals, which were seen by some as being able to pass through the treatment system and enter the drinking water supply, for example, 'Varying amounts of pathogens, pharmaceutical chemicals … and other trace chemicals are able to pass through the treatment and filtering process, potentially causing danger to humans' (C3.S11.A4). On the other hand, there were those who thought the process would be safe, particular if the water met drinking water standards. In the data, there were examples of risk and quality perceptions of water reuse being judged based on perceptions of the existing water supply or other everyday activities (particularly the consumption of food and beverage products). These responses were often anchored to anecdotes or personal experiences and negative perceptions of the existing quality of water supply (such as water hardness or taste). A repeated example was that the water already tasted bad and therefore the reuse scheme would not make this worse (some speculated that recycled water might taste better).

Trust in London's water resource management was identified in the analysis as influencing responses to the proposal across all six cases. For instance, a lack of trust was directed towards a range of organizations, including the water company (and particularly its privatized nature), the British government and the European Union. The lack of trust was often associated with the failure of such organizations to meet consumer expectations, including failure

(particularly on the part of the water company) to repair water leaks. Other reasons for this lack of trust included scepticism towards the motivation of the water company (which was described as being out to make a profit or increase prices) and a lack of perceived control (or influence) over the outcomes of water resource management decisions. In terms of ways to improve trust, the role of communication was identified. A number of comments highlighted perceived communication problems that were then linked with a lack of trust, for example, 'The biggest concern is what they don't take out, drugs, hormones antibiotics etc. That's the stuff that really does damage to us. *But it's never talked about is it?*' (C4.S16.A6 – emphasis added).

Though the theme of trust in water resource management consisted of predominantly negative sentiments towards the reuse scheme, some positive sentiments were identified. These were particularly associated with regulations to control drinking water safety and referred to both UK drinking water standards and European water quality regulations. Some comments also expressed a high degree of trust in regulators, suggesting that they wouldn't allow water companies to supply unsafe water. Moreover, while many comments expressed a lack of trust regarding the water company's financial motivations (e.g., they might increase water bills), some instead speculated on the potential for gains if recycled water were less expensive.

The comments articulated various perspectives on a number of underlying problems contributing to the water management challenges described in the articles. These perceptions of root causes were used to support preferences for management options, particularly relating to population growth and water infrastructure preferences. These types of perceptions were particularly evident in comments with a negative sentiment towards the proposed reuse scheme. Population growth was perceived as driving the water supply deficit, and many expressed strong views that population growth (particularly immigration) should be limited and that other infrastructure (e.g. housing, transport, water) was already inadequate. A number of commenters voiced preferences for other supply-side solutions such as new reservoirs, water transfers or desalination.

Perceptions, and particularly personal experiences, of the climate meant that some comments argued that London (or the UK more generally) has sufficient rainfall and therefore additional water resources were not necessary (if they were managed effectively). The counter-claim to this was also evident in comments which argued that the IPR scheme was a good idea because the region was becoming drier. Some comments suggested that climate change was not occurring and that more energy-intensive seawater desalination should therefore be the preferred solution. This theme describing perceived root causes of water management problems was dominant across the cases, with the exception of the *Guardian*, where there was relatively less interest in this type of argument.

Environmental conservation values were also identified and often in comments with negative sentiments towards the IPR scheme. These values influenced preferences for water resource conservation that prioritized reducing network leakage and behaviour change over the need for a new source of water. Environmental values were identified that exhibited preferences for other supply-side solutions as well, such as rainwater harvesting and community non-potable reuse instead of the IPR scheme.

Across the comment data, and all cases, a frequent response was that all water is already naturally recycled and that therefore the principle of IPR was not surprising or contentious. Similar comments referenced popular knowledge or the belief that the practice already

happens in London (i.e. *de facto* IPR), for example, 'I thought we had been drinking recycled water for years' (C1.S2). Similar responses often cited the belief (also introduced in the articles) that drinking water in London has already passed through 'several sets of kidneys' before it reaches the tap. Finally, knowledge of water reuse (and technology such as reverse osmosis to manage health risks) being used in other international settings (e.g. Singapore) was drawn on in some comments to lend support to the principle of IPR.

Framing effects

Though there were some identifiable differences in the types of framing employed by the news articles, the analysis did not highlight any apparent related differences in the themes or in the relative strength of sentiment expressed in the comments. Therefore, the analysis did not find evidence that the media frames used in the news articles had any influence on the patterns of responses that the articles elicited (Table 2). For example, despite the issue-specific 'toilet to tap' framing employed in the articles, the origin of the water was described as unimportant by some (particularly those who expressed the view that 'all water is recycled'). Instead, what the analysis highlighted was that some reactions were largely consistent across the six cases regardless of what information was present in the article and how it was presented. Examples of consistent reactions included negative sentiments towards the reuse proposal that were related to perceptions of root causes like population growth (a subject for which the views in the comments were generally much stronger and far more diverse than in the articles) and preferences for alternative solutions (particularly fixing existing water network leaks).

Health-risk concerns from chemicals (e.g. hormones, pharmaceuticals) were expressed in the comments across all cases. However, only the *Guardian* article had included this aspect in its problem frame. Conversely, another characteristic of the comments that was consistent across all cases was the absence of responses describing the longer-term benefits of water resource planning, a subject which was mentioned by all the articles. Only one case (the *Guardian*) included comments that articulated a perceived benefit from longer-term planning. Thus, these findings provided more evidence that the media frames being used in the articles were not significantly influencing the responses.

The analysis showed that descriptions of the water cycle, *de facto* IPR and of other international water reuse schemes were being used positively in the comments, in support of the IPR scheme, irrespective of an article's framing. Moreover, knowledge of water treatment technology (such as reverse osmosis) and water quality regulation were raised across the comments of multiple cases as valid ways of managing safety, even when such topics were not raised in the articles themselves. Therefore, though the news event could be interpreted as having resonated with popular knowledge, the articles' frames could not be interpreted as having a framing effect on online responses. In summary, existing attitudes (including attitudes to certain socially charged and political issues) and popular knowledge appeared to have more influence on the responses than the news articles themselves. These observations, to some extent, probably reflect established differences between the readerships of the different publications (as mentioned previously), people gaining knowledge from different sources, and the longer-term agendas these different media organizations promote.

Table 2. Comparison of article themes with responses, including the relative strength of the sentiment expressed towards the proposal.

	Description of context			Perceived driving factors			Perceived scheme barriers			Perceived impacts			Risk management initiatives		
Case	Reuse already occurs	There are other options	IPR process	Pop. growth	Climate	Mgmt of water resources	Yuck	Public percep-tion	Cost	Health risk	Env. impact	Future-proof-ing	Existing research	Water treat-ment technol-ogy	Quality stand-ards (drinking water)
1.	A+, C+	C–	×	A, C–	×	C–	A–, C–	×	C–	C–	×	A+	A	C+	×
2.	A+, C+	A+, C–	A	A, C–	A–, C–	C–	A–, C–	×	C–	C–	×	A+	A	A, C+	A+, C+
3.	A+, C+	A+, C–	A	A, C–	A–, C+	C–	A–, C	A–	C–	C	×	A+	A	A+	A+
4.	A–, C+	A+, C–	A–	A–, C–	A–	C–	A–, C	×	C+	C–	×	A+	×	C+	A
5.	A, C+	A+, C–	A	A, C–	A–, C+	C–	A–, C–	A–, C–	A–, C+	A–, C–	A, C	A+, C+	×	C+	C+
6.	A–, C+	A+, C–	A	A–, C–	A–	C–	A–, C–	A–	C–	C–	×	A+	×	C	×

1 = BBC, 2=Daily Mail, 3 = Evening Standard, 4 = Express, 5 = Guardian, 6 = Telegraph.
A = present in article, C = present in comments, +/– = indicates a dominance of a positive or negative sentiment towards the proposal × = not identified in either the article or comments.

Discussion

This study adds support to previously highlighted benefits of using online comments to capture snapshots of public reactions to water-related events and proposals (Russell-Verma et al., 2015), also noting that some time is necessary to collate and analyse these types of data. Though there are recognized limitations (discussed previously) associated with such data, they can offer a near-real-time view of public responses as they emerge. In this study, the analysis of online comments highlighted the diverse ways in which the public responded to the IPR proposal for London as described by six prominent UK news organizations. Moreover, the data showed a familiarity with the water resource management context (as well as related social and political factors). Thus, in spite of the sample not being representative of London's general public, it was evident that it did represent how some people (with knowledge of the context) reacted, providing useful insight into the potential breadth of public opinions. As there is a desire to extend public engagement and participation around water reuse proposals (Hartley, 2006), online platforms may potentially offer innovative ways to experiment with different messages and techniques.

Analysis of online comments and social media data is likely to become more common – both in general and in the context of water management. The findings of this study draw attention to the need to consider more reflexive, mixed-methods approaches (see e.g. Doria, Pidgeon, & Hunter, 2009) that can incorporate social media data analyses, particularly in the context of evaluating the potential breadth of public responses to water reuse scheme proposals. Complementary methods could include questionnaires, focus groups and analysis of documents produced by policy forums or campaign organizations. The incorporation of interpretive approaches may help improve attempts to understand public acceptance of water reuse (Fielding & Roiko, 2014), which can struggle to account for how different people interpret meaning (Marks, Martin, & Zadoroznyj, 2008). This insight also corroborates conclusion from a related UK study (Russell-Verma et al., 2015), providing additional, independent evidence of the benefits of exploring the qualitative richness of online comment data.

Water reuse has a low profile in the UK, so it is not surprising that comments displayed favourable attitudes towards other supply-side solutions (e.g. water transfers) – other studies have also indicated that these preferences are well established (Russell-Verma et al., 2015). The present findings indicate a tendency for the comments to draw on more generic perceptions of the underlying problems contributing to the water resource management challenge, such as population growth. Conversely, issue-specific frames such as 'toilet to tap', which were prominent in the news articles, did not strongly feature in the comments. This study, therefore, provides some support to other IPR studies showing that people's underlying attitudes or values might underpin their perceptions of water supply problems and their associated reactions to water reuse schemes (Price et al., 2012). The present findings indicate that, in this case and in similar contexts, people's perceptions of certain underlying root causes of water management problems may strongly influence their initial reactions to water reuse scheme proposals. Thus, public outreach that does not sufficiently engage with these concerns may mean that some negative perceptions continue to undermine single communication efforts.

This study was the first known attempt to explore how the framing of an actual news event (the announcement of a real IPR proposal for London) may have influenced unsolicited public responses to water reuse through the use of 'naturally occurring' online data. Moreover,

despite the small sample of news articles, these did demonstrate how the breadth of prominent UK news media could vary the framing of the IPR scheme under question. The lack of evidence of the influence of media framing, in this case, is likely to be due in part to the short timescale considered. This supports a previous study suggesting limited short-term influence of news media reporting on a water reuse proposal (van Vuuren, 2009). Though it has been suggested that media framing contributes to polarizing attitudes towards water management proposals (Wei et al., 2015), this may be set by longer-term agendas (Carvalho & Burgess, 2005; Leong, 2010). Longer-term media agendas may, therefore, challenge single media communication events of IPR scheme proposals and supersede more issue-specific frames if they shape people's perceptions of more general issues such as population growth.

However, this research also suggests that single media events may allow water resource planners, public relations experts and academics to experiment with communicating issue-specific themes, such as referring to popular knowledge of the existing water supply and health risk contexts, and emphasising new water safety initiatives, specific research activities and short-term IPR scheme benefits. These claims are supported by previously suggested benefits of promoting public deliberations around the water cycle (Lyytimaki & Assmuth, 2014) and water safety (Russell et al., 2008). Building these narratives may help counter longer-term agendas being set by the media or other stakeholders and contribute to the continuous communication needed to build public understanding (Kemp, Randle, Hurlimann, & Dolnicar, 2012).

This study did not find evidence that media speculation on the health risks associated with reuse affected the public response in comments, as has been suggested for other scheme proposals (Ross et al., 2014). This finding is consistent with related research, suggesting other influences, such as trusted opinion leaders (van Vuuren, 2009). In contrast to other findings (Lyytimaki & Assmuth, 2014), lack of attention to relevant risks was not observed in the comments. However, the findings did show a lack of attention to scheme benefits (or gains), in both the articles and the comments. There was limited attention to short-term benefits across all data, and the comments did not reflect the articles' framings of the longer-term benefits of water resource management planning. This could relate to people tending to concentrate on more immediate concerns, such as health risks, instead of longer-term benefits, such as water security for future generations (Kemp et al., 2012). The implication of the findings of this study is that promotion of IPR schemes in the media may be aided by the better articulation of more immediate or tangible benefits to help improve public perceptions.

Conclusion

The analysis found no evidence that the media's framing of a single news event describing a water reuse scheme proposal for London had a strong influence on online responses. Instead, people's perceptions of more general causes of water management problems, environmental values and prior knowledge of the water cycle were plausibly more influential. Though constrained by limitations on the generalizability of the findings, this study suggests that online comments can help highlight themes describing positive sentiments towards the principle of water reuse and to the specific reuse proposal. Moreover, individual media events can offer useful opportunities for water resource planners, public relations experts and academics to explore the impact of different issue-specific framings, such as popular

knowledge of the water cycle and areas of confidence in water safety initiatives to manage perceived risks. There is a need for further exploration of how message themes around water safety initiatives and short-term benefits might affect public support for water reuse schemes. There is also a need to build understanding of how public engagement methods can be developed that sufficiently engage with diverse concerns, particular regarding broader concerns linked to perceptions of water resource management. Finally, this study also raised a number of other avenues for future research, particularly related to theoretical, methodological and practical aspects of using online platforms and social media to support public engagement research.

Note

1. C = Case, S = Source, A = Article. The full list of cases, sources and articles is shown in the Appendix, Table A1.

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Appendix 1

Table A1. Online news cases: summary of Internet sources for news articles and online comments and reason for their inclusion or exclusion from analysis

Case	Article and comment sources	Ref.‡	Date	Title	Source incl.?	Notes on inclusion or exclusion	Comments		
							Excl.	Coded/ total	%
1. BBC	BBC article	C1.S1.A1	10/5/13	London 'could drink treated sewage' - Thames Water	Y	UK-wide news source. No comments	-	0/0	n/a
	BBC London – Facebook	C1.S2	10/5/13	London 'could drink treated sewage'	Y†	Open forum with link to article. Extra introduction text analyzed	-	8/11	73%
	BBC Radio 2 – Facebook	C1.S3	10/5/13	London 'could drink treated sewage'	Y†	As above	-	6/31	19%
	BBC Radio London – Facebook	C1.S4	10/5/13	London 'could drink treated sewage'	Y†	As above	-	2/3	67%
	Reddit: London forum (link to BBC article)	C1.S5	10/5/13	BBC News - London 'coulddrink treated sewage'	Y*	Included as comments	-	12/15	80%
	This is big brother - UK forum	C1.S6	10/5/13	London 'could drink treated sewage - Thames Water	N	Copies BBC article. Few comments, some only images. Restricted forum	7	-	-
	Twitter (Tweets with article link)	C1.S7	10/5 – 28/6/13	n/a	Y*	Included as comments	-	11/45	31%
2. Daily Mail	Daily Mail article	C2.S8.A2	10/5/13	Would you drink sewage? What millions will be asked as suppliers desperately try to beat water shortages	Y	UK-wide news source. Article with comments		200/ 685	29%
	Daily Mail – Facebook	C2.S9	10/5/13	Debate: Would you drink recycled toilet water?	Y†	Open forums with link to article. Extra introduction text analyzed		51/ 116	44%
	Daily Mail article	C2.S10.A3	23/10/14	Would YOU drink water recycled from toilet waste? Two in three back plans to look at using treated sewage	N	Excluded. Reports on Guardian article (Case 5, 10/5/2013). Published in 2014	76	-	-
	Twitter (tweets with article link)	C2.S7	10/5/13	n/a	Y*	Included as comments		3/12	25%
3. Evening Standard	Evening Standard article	C3.S11.A4	9/5/13	Drinking treated sewage could be the answer to the capital's water shortage, says Thames Water	Y	London-based news source. Article with comments		28/28	100%
	TNT article	C3.S12.A5	10/5/13	Londoners could be asked to drink recycled sewage	N	UK news source (aimed at antipodean expats). Reports on E.S. Only 1 comment	1	-	-
	TNT – Facebook (link to TNT article)	C3.S13	10/5/13	Londoners could be asked to drink recycled sewage water	N	Link to TNT article. Insufficient comments	3	-	-
	Population Matters – Facebook	C3.S14	11/5/13	New water source proposed for crowded London - your toilet!	N	UK-based environmental site. Exclusive forum. Few comments. Link to E.S. article	9	-	-
	Navitron (UK renewables forum)	C3.S15	10/5/13	Thames Water to recycle sewage to drinking water	N	Restricted use of site. Link to E.S. article.	8	-	-
	Twitter (Tweets with article link)	C3.S7	10-22/5/13	n/a	Y*	Included as comments		11/32	34%
4. Express	Express article	C4.S16.A6	10/5/13	So, would you like to drink recycled sewage? - Weird – News	Y	Article and comments included		9/9	100%
	Express – Facebook	C4.S17	10/5/13	So, would you like to drink recycled sewage?	Y	Open forums with link to article. Extra introduction text analyzed		25/42	60%
	Twitter (tweets with article link)	C4.S7	10-11/5/13	n/a	N	No comments coded (no valid content)	9	-	-

(*Continued*)

Table A1. (*Continued*)

Case	Article and comment sources	Ref.‡	Date	Title	Source incl.?	Notes on inclusion or exclusion	Comments		
							Excl.	Coded/ total	%
5. Guardian	Guardian article	C5.S18.A8	10/5/13	Poll: are you happy to drink recycled sewage water?	Y	UK-wide news source. Article with comments		67/98	68%
	Guardian (Greenslade blog)	C5.S19.A9	10/5/13	Telegraph debunk urban myth	N	Blog comments on Telegraph article. Comments not responding to an article	12	-	-
	Inhabitat (international blog)	C5.S20. A10	10/5/13	Thames water to transform London's sewage into drinking water	N	Reported on Guardian. Few comments	1	-	-
	Inhabitat – Facebook	C5.S21	10/5/13	Thames water to transform London's sewage into drinking water	N	Non-UK source.	31	-	-
	Green-alerts: Environmental news	C5.S22. A11	15/5/13	London set to drink recycled sewage	N	Reports on Guardian article. No comments	0	-	-
	Grist-blog: Environmental news	C5. S23A.12	14/5/13	London May soon be drinking recycled sewage	N	Non-UK. Reports on Guardian article	5	-	-
	MNN: Environmental news	C5.S24. A13	15/5/13	In the future, will treated toilet water flow through London's taps?	N	Non-UK. Reports on the Guardian & BBC articles. No comments	0	-	-
	Nairaland Forum	C5.S25	22/5/13	London To Transform Sewage Water In To Drinking Water	N	Online forum based in Nigeria. Copies report from Inhabitat	80	-	-
	Heath News NG	C5.26.A14	23/5/13	Stakeholders Debate Hygiene As London Plans To Convert Sewage Into Drinking Water	N	Nigerian health news site. Content derived from the Guardian. No comments	0	-	-
	Care2: Environmental news.	C5.S27A15	13/5/13	Would you drink recycled water to conserve water?	N	Non-UK. Reports on the Guardian article	134	-	-
	Twitter (tweets with article link)	C5.S7	10/5-14/6/13	n/a	Y*	Included as comments	-	15/66	23%
6. Telegraph	Telegraph article	C6.S28. A16	9/5/13	Householders asked if they would drink treated sewage water	Y	UK-wide news source. Article with comments	-	87/ 107	81%
	Twitter (tweets with article link)	C6.S7	9/5-6/6/13	n/a	Y*	Included as comments	-	2/23	9%
7. UK – Other	The Bucks Herald & Berkhamsted	C7.S29. A17	10/5/13	Thames Water asks: 'Would you drink treated effluent'?	**N**	Limited readership. Few comments.	12	-	-
	London Loves Business	C7.S30. A18	9/5/13	Londoners could be drinking recycled sewage in years to come	**N**	Only one comment. Specific to London but site with limited reach	1	-	-
	London Loves Business – Facebook	C7.S31	9/5/13	Londoners could be drinking recycled sewage in years to come. But don't poo poo the plans till you see them	**N**	Links to L.L.B. article. No comments	0	-	-
	BBC article	C1.S32. A19	20/5/13	Southern Water could recycled wastewater	**N**	Not specific to London, no comments	0	-	-
	Reddit – London-based forum	C7.S33	9/5/13	What are your views on drinking sewage water?	**N**	No link; not specific to any article	5	-	-
8. Int'l.	FNB News	C8.S34. A20	13/5/13	Thames Water seeks views on plan to recycle sewage	**N**	Online news site in India. No comments.	0	-	-
	Domain-b	C8.S35. A21	11/5/13	Thames Water proposes recycled water for Londoners	**N**	Business news (India). No comments.	0	-	-
	Primary articles included	**6/21**		**Included Internet sources**	**13/35**	**Comments excluded**	**394**		
						Comments coded/total included	**537/1,323**		**41%**

‡C = case, A = article, S = source. †Additional introduction text on Facebook included in analysis of article. *Only comments included in analysis.